EXPLANATION OF PLATE 12.

Fig. 1. *Limnæa.* Diagram showing relative position and size of cells and fibres in the ganglia. *g.a.*, Abdominal ganglion; *g.b.*, buccal ganglion; *g.c.*, cerebral ganglion; *g.pd.*, pedal ganglion; *g.pl.*, pleural ganglion; *g.v.*, visceral ganglion.

Fig. 2. *Aplysia.* Section across buccal ganglia, built up from several methylene-blue preparations.

Figs. 3, 4, 5, & 6. *Aplysia.* Different types of uni-, bi-, and multipolar cells from the pleural ganglia. In figs. 3 *a* and 4 the axis process was traced into a nerve.

Fig. 7. *Aplysia.* Section across visceral ganglia, showing—*a*, group of small cells; *b*, ordinary cells of ganglia; *c*, branching fibre from nerve; *d*, nerve passing over ganglion.

Fig. 8. *Aplysia.* Section of general epidermis showing—*c* and *c'*, sensory cells; *pl.*, subepithelial nerve-plexus.

Fig. 9. *Aplysia.* Section of osphradium. *n*, Nerve; *g*, ganglion; *a* & *b*, sensory cells and their processes, and at *c* one of the latter branching.

Fig. 10. *Aplysia.* Osphradial epithelium, with group of sensory cells showing mode of termination.

A Contribution to the History of New Zealand Echinoderms.

By H. FARQUHAR. (Communicated by T. W. KIRK, F.L.S., Government Biologist, Department of Agriculture, New Zealand.)

[Read 4th February, 1897.]

(PLATES 13 & 14.)

THE material from which the following notes have been drawn up consists principally of a collection of Echinoderms made at Nelson by Mr. E. Lukins, and a small but exceedingly interesting collection brought from Raoul or Sunday Island by Mr. A. A. S. Danby, who was a passenger in the Government steamer 'Hinemoa' on her last annual trip to the Kermadecs. My thanks are due to these two gentlemen for their kindness in placing these valuable collections in my hands.

I give an account in this place of the collection from the Kermadec Islands, although the marine fauna of these islands belongs rather to the tropical division of the Australian Region than to New Zealand. The islands can, however, be most conveniently worked from New Zealand, as they now form part of this Colony, having been annexed in 1887.

I take this opportunity of correcting errors in my previous paper on New Zealand Echinoderms (Trans. N. Z. Inst. vol. xxvii. p. 194). Throughout that paper I have inadvertently used the wrong descriptive terms for the pedicellariæ: "forcipiform" should be "forficiform," and *vice versa*. Corrections of mistakes in nomenclature will be found noted where necessary.

I desire to acknowledge my great indebtedness to Mr. Sladen's admirable monograph of the Asteroidea ('Challenger' Report, vol. xxx.). He has there thrown a flood of light on this class, and reduced to order a mass of material which was largely in a state of chaos. The late Mr. Lyman's monograph of the Ophiuroidea ('Challenger' Report, vol. v.) has also been of much assistance, enabling me to identify species, and place them in their proper systematic position. Every worker at the Echinoderms must be thankful for these two important works.

The identification of specimens is often rendered a matter of considerable difficulty by the limited number of works of reference available in New Zealand; and students of nature feel the disadvantage of being so far away from all the great scientific libraries.

I had hoped to have published a complete list of New Zealand Echinoderms, with synonymy, references, and distribution of the species, which I have compiled; but one or two doubtful points in the synonymy have occasioned delay in publication.

ECHINOIDEA.

Echinocardium australe, *Gray*.

In a former paper ("Notes on N. Z. Echinoderms," Trans. N. Z. Inst. vol. xxvii.) I stated that the specimens of *Echinocardium* collected by me in the Wellington Harbour differed markedly from the Australian form *E. australe*. I have since received a fine example of *E. australe*, and a series of intermediate specimens, collected by Mr. Lukins at Nelson. The form which is abundant in Wellington Harbour is therefore merely a local variety of the common Pacific species *E. australe*. This species is remarkable for its range in depth, extending from a few feet to 2675 fathoms, at which great depth it was taken near Japan by the naturalists of the 'Challenger' Expedition. Its geographical range is also great, including the whole of the Southern Ocean, and extending northwards to Japan.

Evechinus chloroticus, *Valenciennes*. (Plate 14. fig. 9.)

Professor Jeffrey Bell, who has exceptional opportunities of studying the great variations of many Echinoderms, will not be surprised to learn that the two small specimens of *Evechinus* in the British Museum, for which he erected his new species *E. raritubereulatus* (Ann. & Mag. Nat. Hist. (5) xx. p. 403), are but young individuals of the common New Zealand form *E. chloroticus*. I have carefully examined a number of young specimens, and I find that they vary a good deal, some of them agreeing well with Prof. Bell's figures. The description, however, appears to be somewhat mixed, ambulacral having been substituted for adambulacral, and *vice versa*. The largest example of this species that I have seen is in the Colonial Museum: the height of the test is 93 mm., the diameter 145 mm., and the longest spine 40 mm.

Tripneustes variegatus, *Klein*.

Two very fine examples of this exceedingly variable and widely distributed species were collected by Mr. Danby at Raoul Island. They differ remarkably from the specimens described by Agassiz in his great work, 'The Revision of the Echini;' but correspond more nearly with those from Mauritius described by M. de Loriol (Mémoires Soc. Phys. de Genève, xxviii. No. 8, p. 25, 1883). The general form of the Kermadec specimens is much depressed, roundly subpentagonal seen from above, actinal surface flat. The poriferous zones are somewhat sunken on the actinal surface; but above the ambitus the whole ambulacral areas are swollen. The actinal cuts are narrow, but deep and well defined. The dimensions are about the same in both specimens:—Height 57 mm.; diameter 114 mm.; diameter of abactinal system 18 mm.; diameter of actinal system 27·3 mm.; width of poriferous zone at the ambitus 9 mm.; length of longest spine 20 mm.

Echinometra lucunter, *Leske*.

A specimen of this species from the Kermadec Islands has been presented to the Colonial Museum, Wellington, by Mr. H. Travers. Both the Echinoids which have been found at the Kermadecs belong to the order of regular Echini (Desmosticha), and both are very variable and widely ranging forms. Their areas of distribution are almost the same, extending from the

Red Sea down the east coast of Africa to India, and through the Eastern Archipelago and the Polynesian Islands to the Kermadecs. The present species (*E. lucunter*) extends to Japan and down the north-eastern coast of Australia to Lord Howe Island. When a thorough search is made at the Kermadecs, no doubt a number of other Polynesian species will be found there.

Strongylocentrotus tuberculatus, *Lamarck*.

This species was recorded from New Zealand by Agassiz in his 'Revision of the Echini,' pp. 165, 451. I am able to verify its occurrence in our seas, as there is a fine New Zealand specimen in the Colonial Museum, Wellington.

Strongylocentrotus eurythrogrammus, *Valenciennes*.

Agassiz, in the work above quoted, does not give New Zealand in the list of localities where this species has been found (pp. 163 & 442); but on p. 238 it occurs in a list of S. Atlantic Echini as a New Zealand species. I have not been able to find any authority for that statement, although it has been twice recorded from the South Pacific. I am able, however, to state that it is certainly a member of the New Zealand fauna, for there are two specimens in the Colonial Museum, which were found near Wellington by Mr. T. W. Kirk.

Centrostephanus Rodgersii, *Agassiz*.

I am able to add this species to our fauna, for there was a New Zealand specimen in the Colonial Museum. Unfortunately the damp had affected it so much that it fell to pieces when an assistant attempted to remove it from the case.

OPHIUROIDEA.

Ophiopeza Danbyi, sp. n. (Plate 14. figs. 7, 8.)

The disc is flat, subpentagonal, and covered with a fine close granulation. It is about 20 mm. in diameter. The length of the arms is about five and a half times the diameter of the disc. They are rather stout, and taper towards the extremity. There are about twelve mouth-papillæ to each angle; they are small, blunt, rounded, subequal, and closely set. The mouth-shields are rather large, roundly elliptical. The side mouth-shields are small, inconspicuous, and irregular in shape. The under

arm-plates are squarish, with rounded angles. The upper arm-plates are oval, broader than long. The side arm-plates bear four blunt, stout, somewhat flattened, subequal arm-spines, about 3 mm. in length. There are two small leaf-like tentacle-scales to each pore. The colour of the disc is greyish brown, and the rays are blackish grey above, slightly variegated with yellowish and lighter grey beneath.

This form may be readily distinguished from all the other species of the genus *Ophiopeza* by the small number of arm-spines (4) and their large size. One specimen of this species was found by Mr. Danby at Raoul Island.

The diagnosis of the genus *Ophiopeza*, as defined by Lyman ('Challenger' Report, vol. v. p. 30), will have to be slightly modified to admit this species.

Ophiopeza cylindrica, *Hutton*. (Plate 14. figs. 4, 5.)

The disc is subpentagonal, with slight indentations at the bases of the arms. The arms are short, about three or three and a half times the diameter of the disc; they taper evenly to a fine extremity. There are six or seven mouth-papillæ on each side of the mouth-angle, the outermost one is small and narrow, the next large and broad; then follow three or four small, rounded, bluntly-pointed ones, and the pair at the apex are somewhat longer and sometimes broader than these. The mouth-shields are rather large and shield-shaped. The side mouth-shields are small and narrow. The under arm-plates are slightly longer than broad, convex without. The upper arm-plates are oblong, with rounded angles broader than long. The side arm-plates bear six or seven short, blunt, compressed arm-spines. There are two leaf-like tentacle-scales to each pore, the outer one smaller than the other. The colour of this species varies very much; some specimens are dark grey, the disc slightly variegated or spotted, and the rays banded with white or pale grey; others are yellowish white variegated with grey, or the rays banded and the disc variegated with bright reddish brown.

Pectinura maculata, *Verrill*.

This species seems to be distributed all round the New Zealand coasts. Mr. H. B. Kirk informs me that it is abundant at Stewart Island, on the sandy bottoms of the inlets and sheltered coves. Mr. Lukins has sent me a specimen which he found at

D'Urville Island; and Mr. Haylock has collected half a dozen specimens under stones at low water near Wellington. The colour in life is chocolate or bright reddish brown above, with a ten-rayed blackish star on the disc, and the upper surface of the rays is sometimes blackish, and the actinal surface pale reddish or purplish.

Amphiura pusilla, sp. n. (Plate 14. figs. 1, 2, 3.)

The disc is rather tumid, circular, with a wavy margin; it is covered with rounded, imbricating, somewhat irregular scales, which decrease much in size near the margin of the disc. The scaling on the actinal surface is much finer and more regular than that on the abactinal surface. The radial shields are pear-seed shape, about twice as long as broad, separated their whole length by a wedge of scales. The arms are short, about four times the diameter of the disc. There are a pair of short, blunt, stout, rounded mouth-papillæ at the apex of the mouth-angle, and one on either side at the base, which is short, blunt, and leaf-like. The first tentacle-scale is long and spiniform. The mouth-shields are roundly heart-shaped, as broad as long. The side mouth-shields are rather large and broad; they do not meet within. The under arm-plates are squarish, with rounded angles and slightly re-enteringly curved sides; they do not nearly extend across the width of the arm. The upper arm-plates are elliptical, broader than long, almost covering the upper part of the arm. The side arm-plates bear six short, rather stout, bluntly-pointed, subequal arm-spines, the uppermost somewhat smaller than the others and directed upwards. Each tentacle-pore is covered by one large, plain, rounded, leaf-like scale. The colour in life is pale yellowish or greyish white; sometimes the disc is speckled and the rays variegated or banded with dark grey.

Not uncommon near Wellington, among the roots of *Lessonia* and *Macrocystis*.

This species is very nearly allied to *Amphiura constricta*, Lyman. It may be readily distinguished, however, from that species by the size of the upper arm-plates, which extend across nearly the width of the arm; by the form of the radial shields, which are much shorter; and the shape of the mouth-plates.

Amphiura elegans, *Leach*.

This little species is abundant on the roots of seaweed in

rock-pools at low water near Gisborne. The specimens collected by me are somewhat smaller than those found in Europe. The colour in life is yellowish or grey, usually vaaiegated or spotted with dark grey.

Ophiopteris antipodium, *Smith*.

A fine specimen of this rare and interesting form was sent me by Mr. Lukins from Nelson. Mr. Lukins notes that it is "rare outside the Boulder Bank, under stones, at low water." The colour of the dried specimen is purplish black with a brownish tinge beneath.

ASTEROIDEA.

Asterias Rodolphi, *Perrier*.

Three specimens of this species were collected by Mr. Danby at Raoul Island; and I am therefore able to add a little to M. Perrier's very brief description (Ann. & Mag. Nat. Hist. ser. 4, vol. xvii. p. 34, 1876).

In the largest specimen, R=95 mm. and r=14 mm.; the number of rays appears to be always seven; they are elongate, cylindrical, tapering towards the extremity, not constricted at the base. There are five somewhat irregular series of spines on the abactinal surface of the rays; those of the median and adjacent series on either side are small and blunt, with granular tips, while those of the outermost series are larger and usually pointed. These larger spines stand upon a regular series of large broad lateral plates, one on every second or third plate. The spines on the disc are small, blunt, and irregularly scattered, sometimes in groups of two or three. All the spines on the abactinal surface are surrounded by wreaths of small forcipiform (crossed) pedicellariæ. There are a few very small sessile forficiform pedicellariæ scattered on the dorsal surface. The marginal plates bear three rather large flattened blunt spines. The armature of the adambulacral plates consists of two small fine cylindrical spines. The madreporic plate is rather small, situated near the edge of the disc. Two of the specimens are dark reddish brown in colour, and the other is pale yellowish, variegated with reddish brown.

This species is nearly allied to *Asterias scabra*, Hutton. The number of rays and series of spines on the rays and the formula of the armature of the marginal and adambulacral plates are the

same in both species. They may be easily distinguished, however, by the difference in size and in the colour of the tube-feet; this latter may be dark in *A. Rodolphi*, but it is certainly not the bright vermilion so strikingly characteristic of the New Zealand species. The skin on the abactinal surface is not so thick, the wreaths of pedicellariæ around the abactinal spines are much smaller, and both kinds of pedicellariæ are smaller and far less numerous than in *A. scabra*.

Asteropsis imperialis, sp. n. (Plate 13, figs. 1, 2.)

R = 58 mm.; *r* = 30 mm.

Form substellate, flat; interbrachial arcs well rounded. Rays short, broad throughout their length, tapering to a rounded extremity. The plates on the abactinal surface are very irregular; on the disc the larger plates are flat, angular, and connected by smaller narrow plates, forming an irregular broad meshwork; on the rays the plates are somewhat rounded and tumid. The marginal plates are thick and large, overlapping, obliquely placed and somewhat irregular. Those of the superior series on the rays are pear-shaped, becoming roundly oblong and transversely placed in the interbrachial arcs. There are ten or eleven plates between the middle of the interbrachial arc and the tip of the ray, both above and below: the outermost one or two are much smaller than the rest. The plates on the actinal surface of the interbrachial spaces are slightly imbricating, forming a closely packed pavement, but not so regular either in form or disposition as in *A. vernicina*. The adambulacral armature consists of two single series, as in *A. vernicina*; the spines of the furrow series are in pairs (two on each plate); they are rather long, thin, and cylindrical; those of the outer series (actinal spines) are single except near the mouth, where the plates bear two spines each, and there may be a plate here and there further out with two spines; these spines are short, rather stout, somewhat flattened, and bluntly pointed. The whole of the actinal and abactinal surfaces is covered with thin transparent skin. The madreporite is not large, but distinct; it is situated near the centre of the disc. The anal orifice is distinct, situated near the centre of the disc, slightly towards the side distant from the madreporite.

In defining the genera *Asteropsis* and *Dermasterias*, Mr. Sladen

gives as a distinguishing character of the former "a pair of specially localized pedicellariæ at the base of the rays on the abactinal surface" ('Challenger' Report, vol. xxx. p. 355).

I have two specimens of *A. vernicina* from Port Jackson; one of them exhibits no trace of these organs, and the other has a pair of elongate excavate pedicellariæ, with two much depressed valves at the bases of three of the rays; and the other two rays have each but one of these organs. These pedicellariæ are present in *A. imperialis*; but they are irregular in number, size, and situation. Two of the rays have a pair of elongated pedicellariæ situated as those in *A. vernicina*; but one of these rays has also two smaller pedicellariæ nearer the extremity, and the other ray has one; another ray has also two near the base, but one is situated more distally than the other, and they are not so elongate as those on the other rays; and two rays have each but one of these organs. These pedicellariæ are more prominent in this species than in the Australian form.

The colour of *A. imperialis* is brilliant red, variegated on the rays and actinal surface with yellow.

A single example of this fine species was collected by Mr. Danby at Raoul Island.

Gnathaster rugosus, *Hutton*. (Plate 14. fig. 6.)

I have a very fine specimen of this rare species which was collected at Nelson by Mr. Lukins. Fig. 6, Plate 14, shows the form and character of the spines on the mouth-plates and the two long spiniform glassy-tipped processes (keels), one on each plate. The specimen is dry, and the spines are somewhat displaced.

Astrogonium sp.

In a previous paper (Trans. N. Z. Inst. vol. xxvii. p. 200) I gave reasons for believing that the form which Prof. Hutton called "*Astrogonium pulchellum*, variety B," would probably prove to be a distinct species. I have since been able to examine a good series of this form, which I have compared with several specimens of *A. pulchellum*; and I find that the differences are so well marked and so constant that I can come to no other conclusion than that it is distinct.

The opinion of Dr. Dendy on the establishment of new species is so good that I take the liberty of quoting it here. The italics

are mine. "In distinguishing species all characters are of use, and a well-marked difference in any one character is, in my opinion, a sufficient justification for a distinct specific name. This, of course, necessitates a good many specific names; but it is better to have too many than too few; and so long as each form is properly described, increase of species only adds to our knowledge, while *the merging of many forms under one name makes hopeless confusion*; for the author who does so seldom thinks it necessary to give an adequate description of each variety; and it then becomes impossible to sort them out and to determine which is really the type of the species." (Trans. Roy. Soc. Victoria, vol. iii. pt. 1, p. 44, 1891.)

I have drawn up a description and figure of this species which I withhold for the present, for it has occurred to me that this may be Gray's species *A. abnormale*, the habitat of which is unknown. Unfortunately I have not seen Gray's description, but only the name in Mr. Sladen's list of known species ('Challenger' Report, vol. xxx. p. 748).

Mr. Lukins has sent me a very fine specimen from Nelson, in which the plates on the dorsal surface are very prominent, almost spherical.

If this be not Gray's *A. abnormale*, I propose that it be called *Astrogonium Huttoni*.

Ophidiaster sp.

The collection made by Mr. Danby at the Kermadecs contains four specimens of an *Ophidiaster* which probably belong to one of the following species:—*O. Germani*, Perrier; *O. pusillus*, Müll. & Trosch., *O. cylindricus*, Lamarck. The two former species occur at New Caledonia, and the latter at the Fiji Islands. I have not seen descriptions or figures of any of these, and I cannot therefore identify my specimens.

In the largest specimens R=120 mm. and r=11·5 mm. There are seven regular longitudinal series of granular plates on the rays, and a series of smaller ones on each side of the furrow outside the outer row of spinelets. The outer adambulacral spinelets are very short, blunt, and slightly flattened, and those of the inner or furrow series are similar, but much finer; both series are single. Those of the outer series are surrounded by granules.

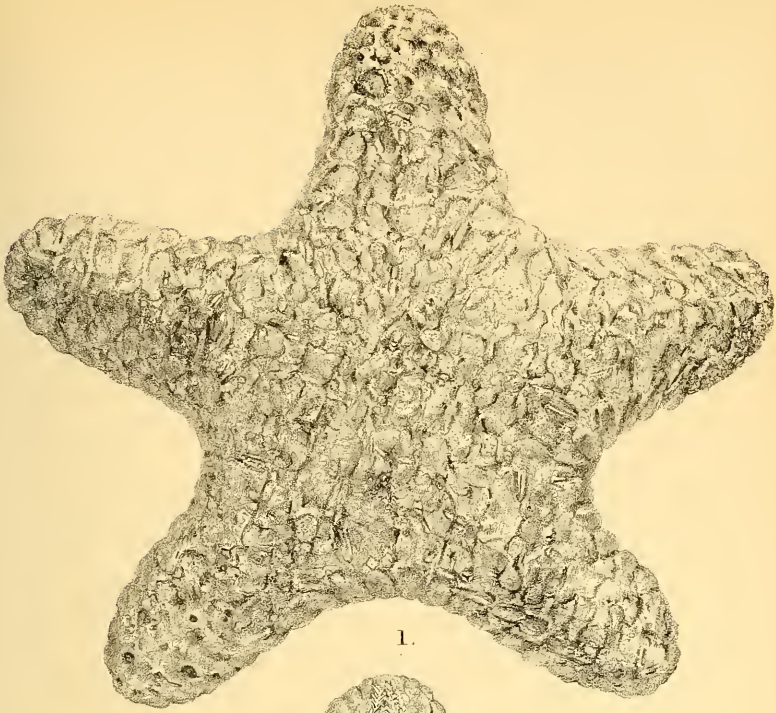
The two series are separated by a band of granules; the granules sometimes extend between the small spinelets of the furrow series. The madreporite is usually nearer the edge of the disc than the centre; it is distinct and rather large. "Small entrenched pedicellariæ of the characteristic figure-of-eight form" are extremely numerous on the areas between the plates with the granules scattered among them, both on the actinal and abactinal surfaces. The colour in the dried state is yellowish, and in life reddish orange.

Asterina regularis, *Verrill.*

A number of specimens of this species which I have collected near Wellington shows that it often belies its name. Two of them have seven rays each, five have six rays each, several have more than one madreporite plate; and there is a specimen in the Colonial Museum with eight rays. Several of these are so distinct from normal specimens of *A. regularis*, that if a series were found in a separate locality, a new species might safely be established for them. Prof. Perrier has described another New Zealand species of this genus, *A. novæ-zelandiæ*; but unless it be very different from *A. regularis*, or has been described from a good series showing a constant difference, it may be one of these abnormal forms, which are not uncommon. I stated (Trans. N. Z. Inst. vol. xxvii. p. 199) that this species occurs in Australia. My authority was the 'Alert' Report. Mr. Whitelegge states, however, that it is not found at Port Jackson (Proc. Roy. Soc. N. S. W. vol. xxiii. p. 202, 1889); and the "good series" of the 'Alert' Report probably belongs to some other form. I have a series of very fine specimens which were sent to me by Mr. Lukins from Nelson. Amongst these are several with two spines on each of the interradial plates on the actinal surface; others have one spine on the large plates near the mouth and two on the smaller ones near the margin. Not unfrequently the four or five large plates immediately outside the mouth-plates are without spines. The adambulacral plates bear two or three spines, forming a single row in the furrow.

Stichaster polyplax, *Müller & Troschel.*

This is the species which I described under the name *Tarsaster neozelanicus*, Trans. N. Z. Inst. vol. xxvii. p. 207, pl. xii. (1894).



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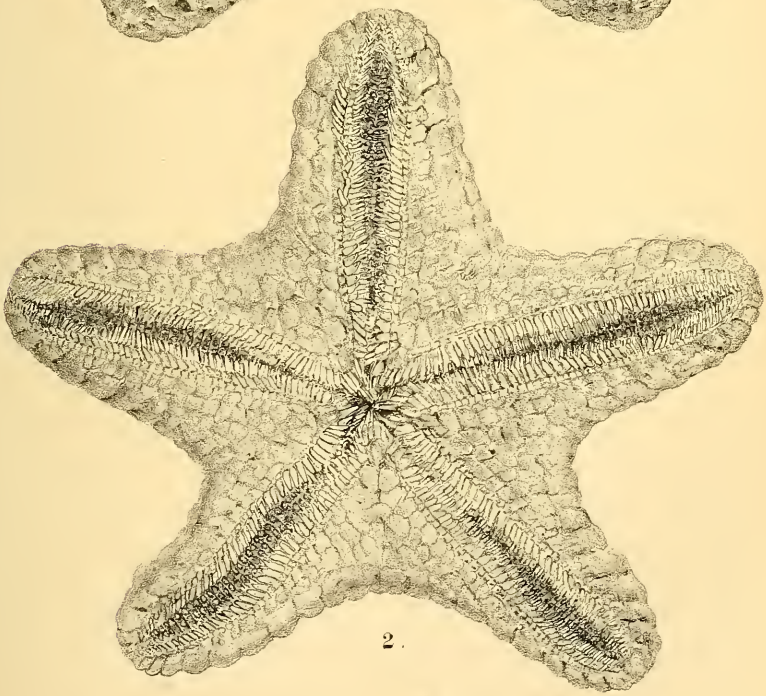

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H.F. del. F.H. Michael lith. Mintern Bros. imp.

ASTEROPSIS IMPERIALIS.